

CLAIMS

1. A lithium rechargeable battery comprising a positive electrode, a negative electrode and a non-aqueous electrolyte,

wherein said negative electrode comprises a copper core material and a negative electrode material mixture layer fixed on said core material,

said negative electrode material mixture layer includes an active material comprising a mixture of artificial graphite particles A and spherical graphite particles B,

said artificial graphite particles A are isotropic artificial graphite particles including graphite structure oriented at random and having:

(1) an interplanar spacing  $d_{002}$  between the (002) planes obtained by a powder X-ray diffraction method being not more than 3.362 Å;

(2) a ratio  $I_{002}/I_{110}$  of the peak intensity  $I_{002}$  attributed to the (002) plane to the peak intensity  $I_{110}$  attributed to the (110) plane, which are found from a diffraction pattern obtained by X-ray diffraction of said artificial graphite particles A molded into a pellet of 1.6 g/cm<sup>3</sup> in density, being not more than 1,000;

(3) a mean circularity of the particles being 0.85 to 0.95;

(4) a particle diameter  $D_{50}$  corresponding to a volume fraction of 50% measured by a laser diffraction particle size

distribution analyzer being 15 to 30  $\mu\text{m}$ , and a ratio  $D_{10}/D_{90}$  of a particle diameter  $D_{10}$  corresponding to a volume fraction of 10% to a particle diameter  $D_{90}$  corresponding to a volume fraction of 90% being 0.2 to 0.5;

(5) a tap density after tapping of 900 times with a stroke length of 18 mm being not less than 1  $\text{g}/\text{cm}^3$ ; and

(6) a specific surface area measured by a BET method being not more than 1  $\text{m}^2/\text{g}$ , and

said spherical graphite particles B having:

(1) a mean circularity of the particles being 0.88 to 1;

(2) a particle diameter  $D_{50}$  corresponding to a volume fraction of 50% measured by a laser diffraction particle size distribution analyzer being 5 to 15  $\mu\text{m}$ ;

(3) an interplanar spacing  $d_{002}$  between the (002) planes obtained by a powder X-ray diffraction method being not more than 3.357  $\text{\AA}$ ; and

(4) a specific surface area measured by a BET method being not more than 8  $\text{m}^2/\text{g}$ .

2. The lithium rechargeable battery in accordance with claim 1, wherein said artificial graphite particles A are obtained by kneading and granulating a base material of pulverized bulk mesophase pitch with pitch in a softened state and/or thermosetting resin, carbonizing the resulting granules at 700 to 1,500°C and graphitizing the carbonized granules at 2,500 to 3,000°C.

3. The lithium rechargeable battery in accordance with claim 1, wherein the content of said spherical graphite particles B in said active material is 5 to 45 wt%.

4. The lithium rechargeable battery in accordance with claim 1, wherein said positive electrode and said negative electrode with a separator interposed therebetween are wound to form an electrode group, said electrode group being accommodated and sealed in a prismatic metal case or a case made of a laminate of an aluminum foil and a resin film.

5. The lithium rechargeable battery in accordance with claim 1, wherein said negative electrode material mixture layer further includes a rubber-like binder containing a butadiene unit and a cellulose-based thickener.

6. The lithium rechargeable battery in accordance with claim 1, wherein said spherical graphite particles B are natural graphite particles and/or natural graphite particles partially subjected to reforming treatment to make only their surfaces amorphous.

7. The lithium rechargeable battery in accordance with claim 5, wherein said rubber-like binder is added in an amount of not more than 3 parts by weight with respect to said active material of 100 parts by weight, and said negative electrode material mixture layer has a density of 1.6 to 1.8 g/cm<sup>3</sup> and a thickness of 40 to 100  $\mu$ m.